Work Plan for PCB Removal and Encapsulation
Big Spring Fish Hatchery, Lower Raceways
Lewistown, Montana

Submitted to:

Montana Fish, Wildlife & Parks
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Table of Contents

List of Figures

List of Tables

List of Appendices

1.0 INTRODUCTION

Olympus Technical Services, Inc. (Olympus) has prepared this cleanup work plan for the Montana Fish, Wildlife & Parks (FWP) to address the presence of paint containing polychlorinated biphenyls (PCBs) on the lower raceways of the Big Spring Fish Hatchery (Site). The work plan includes sections that describe PCB characterization activities and assess removal options. The preferred option is sandblasting of the PCB paint from the concrete surface of the raceways, encapsulation of PCB-impacted concrete, and follow-up performance monitoring. Because this option only involves partial removal of the PCBs, FWP is submitting this work plan to the US Environmental Protection Agency (EPA) for approval.

2.0 SITE CONDITIONS

The Site includes the lower raceways at the Big Spring Fish Hatchery located in Section 5, Township 14 North, Range 19 East, Montana Principal Meridian, Latitude 47° 00' 24.3" North, Longitude 109° 20' 53.5" West, as shown on Figure 1. The lower raceways consist of seventeen 111-foot long raceways, thirteen 71-foot long raceways, and one 244-foot long canal raceway. Each raceway is approximately 7.5 feet wide and the walls are approximately 3.5 feet high. The exterior surfaces of the raceways are concrete, although some steel is present in the form of channel iron through which the gates are placed. An aerial photograph showing the hatchery layout is provided on Figure 2. The aerial photograph in Figure 2 was acquired in June 1989, before the canal raceway at the south end of the raceways was modified by extending the short and long raceway walls to the south end wall.

The raceways were constructed in 1959 or 1960 and, at some point after that time, a blue-green PCB-containing paint was used to coat the short and canal raceways. A red paint began to be used at a later unknown time and it was placed on the short and long raceways, but not the portion of the canal raceway located upstream of the short raceways. The distribution of paint used on the various raceways is shown on Figure 2. The FWP discovered that the paint contained PCBs in August 2003 when a sample of the paint was analyzed and found to contain 1150 milligrams per kilogram (mg/kg) PCB (Aroclor 1254). This initial paint sample was collected from a short raceway where both the blue-green and the red paint had been applied.

Additional paint samples were collected by FWP in December 2003 and the results indicated that there had been at least three types of paint used at the Site. A blue-green paint was used throughout the canal raceway and short raceways and on the south wall and the southernmost 11 to 13 feet of floor in the long raceways. A sample of the blue-green paint collected from the canal raceway contained 86,500 mg/kg PCB. A red paint purchased prior to 1980 was used on all of the raceways except for the portion of the canal raceway upstream of the short raceways and a sample of it contained 674 mg/kg PCB. A sample of red paint purchased after 1980 did not contain PCBs above the method detection limit (0.15 mg/kg).

Several paint samples were also analyzed for total lead. The paint sample collected in August 2003 from a short raceway contained a concentration of 2130 mg/kg lead. The sample of blue green paint collected from the canal raceway in December 2003 contained 67.4 mg/kg lead and a sample of a combination of all paint types collected from a short raceway in December 2003 contained <0.5 mg/kg lead.

Site characterization was conducted in December 2003 to assess the extent to which PCBs had penetrated the concrete raceways. Characterization was conducted in accordance with a work plan, dated October 30, 2003, which was approved by the U.S. Environmental Protection Agency (EPA) in correspondence dated November 25, 2003.

Characterization included the collection and analysis of depth-integrated concrete samples. Sample locations were selected using Visual Sample Plan (VSP) 2.2 (PNNL, 2002), which is a software tool for selecting the number and locations of environmental samples so that the results of statistical tests performed on the data have the required confidence for decision making. VSP was developed by the Pacific Northwest National Laboratory and sponsors include the EPA, Department of Energy, and Department of Navy. The sampling goal used for the Site was to detect a hot spot of a given size at a 95% probability of detection. Because the Site conditions were anticipated to be uniform, a hot spot size of 10% of the total sample area was used to select sample locations. The VSP report summarizing the sampling design used, associated statistical assumptions, and selected sample locations is provided in Appendix A. Based on this method, ten sample locations were selected as shown in the VSP report and on Figure 3. The sample location figure in the VSP report shows the relative position of each of the raceways with the walls folded flat.

Concrete samples were collected using a sampling procedure developed by EPA Region 1 that produces a uniform, finely ground powder which is easily homogenized. The standard operating procedure for this method is provided in Appendix B. The Region 1 method utilizes a rotary impact hammer drill with a carbide drill bit to generate the sample.

All drill bits and sample collection devices were decontaminated per the standard operating procedures (Appendix B), including a soapy water wash, followed by a potable water rinse, followed by a deionized water rinse. Field activities were documented in a field log book.

A depth integrated sampling program was used to assess the degree that PCBs penetrated into the concrete. A grinder was used to remove the surface veneer of paint over the concrete. Following paint removal, four depth integrated samples were collected at each sample station. Each sample represented a 0.5-inch depth interval, i.e. 0-0.5 inches, 0.5-1.0 inches, 1.0-1.5 inches, and 1.5-2.0 inches. A total of 40 concrete samples were collected from the ten sample locations. Samples were placed into laboratory-supplied clean sample jars and labeled with the project identification number, sample number, and date and time of sampling. The samples were placed into a cooler on ice for transport to the analytical laboratory. Chain-of-custody procedures were used to track samples from collection, to shipment, to laboratory receipt.

Quality assurance/quality control (QA/QC) procedures were followed to ensure the provision of reliable, accurate, and defensible data. Equipment blanks were collected at a frequency of 1 per 20 samples; two equipment blanks were collected. The equipment blanks were prepared by placing the decontaminated drill bit and sampling utensils in a large decontaminated stainless steel bowl. Deionized water was poured into the bowl, mixed with the sampling tools, and decanted into a sample container. Field duplicate samples were collected to measure precision and representativeness of the sample. Field duplicates were prepared at a frequency of 1 per 20 samples; two field duplicates were collected.

The samples were submitted to Energy Laboratories, Inc. (Energy) in Helena, Montana, and analyzed for PCBs according to EPA Method 8082. Energy follows EPA QA/QC criteria and is certified by the National Environmental Laboratory Accreditation Council for the analysis of hazardous and solid wastes. Initially, only the QA/QC samples and natural samples collected from depths of up to 1 inch were analyzed for PCBs. Preliminary results indicated that PCBs had penetrated at least 1 inch into the concrete in the short raceways while PCBs were not detected above method reporting limits in samples collected from the long raceways at depths greater than 0.5 inches. The remaining samples collected from the short raceways at depths of 1 to 2 inches were also analyzed for PCBs. The samples collected from the long raceways at depths of 1 to 2 inches were not analyzed.

The laboratory report is provided in Appendix C and the results are summarized in Table 1. The data were reviewed for QA/QC purposes and a data validation form is provided in Appendix C. The review indicated that the data are considered valid.

PCBs were detected in the concrete at depths of up to at least 2 inches in samples collected from the short raceways (raceways 44 through 56). These raceways were originally painted with the blue-green paint that has been found to contain PCBs at a concentration of 86,500 mg/kg. Although the canal raceway was not sampled, it was painted with the blue green paint and it is assumed that PCB concentrations in it are similar to that in the short raceways. PCBs were detected over the interval of 0 to 0.5 inches in samples collected from three of the six long raceway locations. PCBs were not detected at depths of greater than 0.5 inches in any of the long raceway sample locations. The areas of the long raceways that were sampled were only painted with the red paint, not the blue-green paint. The south wall and 13 feet of the southern end of the floor of the long raceways were painted with the blue-green paint and it is assumed that PCB penetration into the concrete in these areas is similar to that observed in the short raceways.

PCB mass in the raceways was calculated to assess partitioning between the paint and concrete. A table summarizing mass calculations is provided in Appendix D. Based on site measurements, the thickness of blue-green paint is estimated at 1/64th of an inch and the red paint at 1/32nd of an inch. Using these estimates, there are an estimated 178 pounds of PCBs in the paint, of which 172 pounds are in the high concentration paint found in the short raceways, canal raceway, and southern ends of the long raceways. An estimated 21.2 pounds of PCBs are present within the concrete, of which an estimated 21.1 pounds occur in the upper 0.5 inch of the concrete beneath the high concentration paint. Using these quantities, an estimated 89% of the PCBs at the Site are present within the paint on the concrete surface and 11% of the PCBs present at the Site have penetrated into the concrete to some distance, although most of the PCBs in the concrete are present in the upper 0.5 inches.

Table 1. Concrete Sample Results - Detected Aroclors

Sample ID	Raceway	PCB	Result	Units
A 0-0.5"	44	Aroclor 1254	18	mg/kg
A 0.5-1"	44	Aroclor 1254	0.47	mg/kg
A 1-1.5"	44	Aroclor 1254	0.12	mg/kg
A 1.5-2"	44	Aroclor 1254	0.019	mg/kg
B 0-0.5"	47	Aroclor 1254	457	mg/kg
K 0-0.5" Field Dupl. of B 0-0.5	47	Aroclor 1254	413	mg/kg
B 0.5-1"	47	Aroclor 1254	2.6	mg/kg
B 1-1.5"	47	Aroclor 1254	0.72	mg/kg
B 1.5-2"	47	Aroclor 1254	0.29	mg/kg
C 0-0.5"	48	Aroclor 1254	88	mg/kg
C 0.5-1"	48	Aroclor 1254	0.97	mg/kg
C 1-1.5"	48	Aroclor 1254	0.54	mg/kg
C 1.5-2"	48	Aroclor 1254	0.1	mg/kg
D 0-0.5"	52	Aroclor 1254	153	mg/kg
D 0.5-1"	52	Aroclor 1254	2	mg/kg
D 1-1.5"	52	Aroclor 1254	0.25	mg/kg
D 1.5-2"	52	Aroclor 1254	0.073	mg/kg
E 0-0.5"	57	Aroclor 1254	0.13	mg/kg
E 0.5-1"	57	Aroclor 1254	0.0074 J	mg/kg
F 0-0.5"	58	Aroclor 1254	0.056	mg/kg
L 0-0.5" Field Dupl. of F 0.5-1"	58	Aroclor 1254	0.08	mg/kg
F 0.5-1"	58	Aroclor 1254	<0.017	mg/kg
G 0-0.5"	65	Aroclor 1254	0.015 J	mg/kg
G 0.5-1"	65	Aroclor 1254	0.0049 J	mg/kg
H 0-0.5"	68	Aroclor 1254	0.015 J	mg/kg
H 0.5-1"	68	Aroclor 1254	<0.017	mg/kg
I 0-0.5"	70	Aroclor 1254	0.024	mg/kg
I 0.5-1"	70	Aroclor 1254	<0.017	mg/kg
J 0-0.5"	72	Aroclor 1254	0.014 J	mg/kg
J 0.5-1"	72	Aroclor 1254	<0.017	mg/kg
WA - Equipment Blank		Aroclor 1254	0.11 J	ug/L
WB - Equipment Blank		Aroclor 1254	<0.5	ug/L

Notes: < indicates analyte not detected above indicated detection limit
J indicates estimated value. The analyte was present but less than the reporting limit.

3.0 CLEANUP ALTERNATIVES

Three potential cleanup alternatives were identified for the raceways and they include: 1) removal of PCB paint and PCB-impacted concrete; 2) demolition and disposal of the raceways; and, 3) removal of PCB paint followed by encapsulation of PCB-impacted concrete to prevent future exposure. Each alternative is evaluated in the following subsections.

One task that is common to each of these alternatives is disposal of PCB impacted wastes. The PCB impacted waste will be disposed of at a TSCA or RCRA permitted disposal facility.

3.1 Removal of PCB Paint and PCB-Impacted Concrete by Blasting

This option involves removal of the paint and PCB-impacted concrete using high pressure water blasting. Under this option, the paint and surface veneer of concrete would be removed from the long raceways and the paint and approximately two inches of concrete would be removed from the short and canal raceways and from the south wall and southernmost 13 feet of floor in the long raceways. Water blasting uses pressure as high as 40,000 pounds per square inch (psi) to break the concrete apart. The machines are often robotic and use shrouds to contain the blasted debris. The equipment is specialized and vendors are restricted to the Midwest and East Coast regions. Water blasting vendors apprised of site conditions believe that it may be feasible, although there are numerous site conditions that would make it difficult. Two of the questions related to the use of this technology include the ability of the machines to adapt to the complex geometry of the raceways and whether the on-site water is of adequate purity to be used as a blasting agent.

Even if it were feasible to blast the PCB impacted concrete from the raceways, the primary problem with this technology is that it would not be feasible to resurface the concrete to tolerances that would be acceptable for future hatchery use. In order to bring the hatchery back into operation the remaining concrete would need to be removed and new raceways constructed. Since the cost to simply demolish and replace the raceways would be much less than the cost of first water blasting the impacted concrete, this option is not given further consideration.

3.2 Raceway Demolition and Disposal

This option involves demolishing the entire facility and disposing of the debris at a solid waste landfill. Demolition would be conducted by workers trained in hazardous waste operations (29 CFR 1910.120). Demolition would need to be conducted in a manner to prevent off-site emissions of PCB dust. This would include demolition within fully contained temporary structures under negative air pressure. Demolition costs are estimated at more than $100,000. The total quantity of concrete and paint in the raceways is estimated at 29,000 in-place cubic feet or 2,200 tons. Transportation and disposal at a RCRA landfill is estimated at $200 to $400 per ton for a total disposal cost of $440,000 to $880,000. The total demolition and disposal cost is estimated to range from $540,000 to $980,000.

This option would require reconstruction of the raceways to restore the site for hatchery operations. The raceway construction costs are estimated at between $2,500,000 and $3,000,000. In addition to cost, a disadvantage to this option is that it requires the use of additional resources, including the concrete, steel, and energy required to replace those materials lost during demolition. Although the raceways are over 40 years old, they are in good shape and have an estimated lifespan of more than 20 years.

3.3 Paint Removal and Encapsulation of PCBs in the Concrete

This option involves the removal of paint from all of the raceways by sand blasting and disposal of the blasting waste (paint, concrete, and abrasives) at a RCRA or TSCA disposal facility. This is the preferred option for the Site and is proposed for EPA approval. Site sampling has indicated that approximately 89% of the mass of PCBs present in the raceways are located in the paint on the raceway surface and that approximately 11% of the PCB mass is in the upper 0.5 inches of the concrete. Less than 1% of the PCBs have penetrated deeper than 0.5 inches into the concrete. Removal of the paint via blasting will effectively remove over 90% of the PCB mass since a thin layer of the most highly impacted concrete will be removed with the paint. The concrete will then be sealed with a PCB resistant sealant. EPA approval of this option is required because PCBs will still be present in the concrete.

All sandblasting and sandblast waste containment will be carried out by contractors with Hazardous Waste Operations (HazWoper) training and medical monitoring prescribed in 29 CFR 1910.120. The contractor will be required to submit and comply with a site specific health and safety plan that meets the requirements of 29 CFR 1910.120.

Dust emissions will be minimized through the use of containment barriers and a dust collection system. The areas being sandblasted will be fully contained and the air in the containment area treated through a high efficiency particulate air (HEPA) filter system prior to discharge to the environment. The inlet and outlet of the raceways will be closed off during sandblast operations to control sandblast wastes. The contractor will be required to cleanup all sandblast waste on a daily basis to minimize fugitive dust emissions. The sandblast waste will be placed in a sealed container.

Performance monitoring will be conducted outside of the containment area to ensure that containment measures are adequate. Monitoring will be conducted for PCBs per National Institute for Occupational Safety and Health (NIOSH) Method 5503 and lead per NIOSH method 7300. The contractor will be required to maintain concentrations below the NIOSH recommended exposure limit of 0.001 milligrams/cubic meter (mg/m^3) PCBs averaged over a 10-hour period and the Occupational Safety and Health Administration (OSHA) permissible exposure limit of 0.05 mg/m^3 lead averaged over an 8-hour period. Monitoring will be conducted on a weekly basis during sand blast operations. Should monitoring results be above the specified levels, then the contractor will take measures to reduce emissions and retesting will be conducted.

Pre- and post-job soil analysis is planned to assess whether adequate ground protection was employed during sand blast operations. Three soil samples will be collected from each of the four directions around the raceways at distances of between 10 and 100 feet from the raceways. Sample locations have been selected using Visual Sample Plan (PNNL, 2004), which is a software tool for selecting the number and locations of environmental samples so that the results of statistical tests performed on the data have the required confidence for decision making. The VSP report describing statistical criteria for one of the areas is provided in Appendix E and the soil sample locations are also shown on Figure 4. At each sample location a 1 square foot template will be placed and a sample of soil ¾ inches in diameter and ½ inch in depth will be collected from the center of the template and at each of the four corners. The five subsamples will be composited into a single sample and analyzed for PCBs according to EPA Method 8082. Pre-job soil impacts are suspected at the site as red and blue paint chips are visible on the ground surface to the south of the raceways. Should PCB impacts be present in the pre-job samples, then the need for post-job soil sampling will be evaluated with EPA staff. Should post-job samples be needed, they will be collected from the same locations and using the same procedures as the pre-job samples.

Sand blasting costs are estimated at approximately $1.50 to $2.00 per square foot, resulting in a blasting cost ranging from $83,000 to $110,000. Dust containment and debris cleanup costs will likely be in the range of $20,000 to $40,000.

Sand blasting will remove an estimated 1/16th inch veneer of paint and concrete over the entire surface of the raceways. This will result in a volume of approximately 290 cubic feet (22 tons) of paint/concrete waste. Sand blasting will likely use approximately 4 pounds of abrasives for every square foot of area blasted. This will add an estimated 110 tons of abrasives to the paint/concrete waste for a total quantity of 132 tons of waste that will require disposal at a solid waste landfill. The cost for transport and disposal of this waste will be in the range of $200 to $400 per ton, for a total disposal cost of approximately $26,000 to $53,000.

FWP will inspect all raceways prior to encapsulation to ensure that all paint is removed. At least two coats of a PCB resistant sealant will be applied to the concrete. The coats will be of contrasting colors so that it will be obvious if the outer surface were to wear away. The coating must prevent migration of PCBs and be non-toxic, flexible, and easily patched if damaged. Several coatings have been identified that meet these performance requirements and two coating options are presented below. While direct testing of the coatings for PCB resistance cannot be completed within the project timeline, an assessment of their resistance can be made based on the sealant's physical properties, the physical properties of PCBs, and resistance tests completed for chemicals with properties similar to PCBs. The vapor pressure of PCBs in general is very low and the reported vapor pressure for Aroclor 1254 is 0.00006 millimeters of mercury (mm Hg) (Monsanto, 1999). The standard atmospheric pressure is 760 mm Hg and the relatively low vapor pressure for PCBs renders vapor migration unlikely. As noted below, the proposed coatings have been tested for resistance to molecules with similar structures to PCBs, such as lubricating oils and hydraulic oils, and the resistance to these materials is high. The proposed coatings are rated for immersion service in many organic solvents including diesel fuel, gasoline, and motor oil. Other coatings may be considered, but they will need to meet the performance specifications of the coatings described below.

One set of coatings that meets these performance requirements is Belzona® 4911 (Magma TX Conditioner) applied as a primer with Belzona® 1341N (Supermetalglide) as a top coat. Chemical resistance data sheets for these products are provided in Appendix F along with product specification sheets, material safety and data sheets (MSDS), and a recommendation from the manufacturer regarding the use of these sealers for these conditions. The Supermetalglide product has been used as a top coat in hatchery applications around the country, including the U.S. Fish and Wildlife Service hatchery in Jackson, Wyoming. Proper surface preparation would be required to ensure the longevity of the sealers. Surface preparation would include the sealing of cracks and expansion joint-type cracks in the concrete. Belzona® has supplied surface preparation and application procedures in correspondence provided in Appendix F.

The Sherwin-Williams Company also produces a polyurea coating and lining system, Envirolastic®, that is chemically resistant and extremely flexible. Envirolastic® has been used at a U.S. Fish and Wildlife Service hatchery in Ellsworth, Maine, as indicated on an information sheet provided in Appendix G. The product is also being used to seal approximately 300,000 square feet of PCB-impacted concrete floor. Product information and chemical resistant data sheets for this product are provided in Appendix G. A moisture vapor control system product (MVT) would be applied to the concrete prior to application of the polyurea coating to seal off water vapor and provide a stronger bonding surface for the polyurea.

The sealed surface will be labeled with the ML Mark in a location easily visible to individuals present in the area. The ML Mark identifies the area as containing PCBs. The coatings and markings will be maintained for the lifetime of the raceways. The cost of surface preparation and sealer application is estimated at $6 to $12 per square foot, for a total application cost of $306,000 to $612,000.

The total capital cost for this option is estimated to range from $435,000 to $815,000. The cost estimate does not include future maintenance or performance monitoring, which is estimated to range from $3,000 to $6,000 per year.

While the sealants have high chemical resistant capabilities, performance monitoring will be conducted to ensure that PCBs are not being released to the environment. Four independent monitoring methods will be used including sampling of the sealant surface, sampling of algae growing on the sealant, sampling of fish reared in the raceways, and sampling of water flowing through the raceways. A sampling and analytical plan for the monitoring is provided in Section 4 of this plan. Annual monitoring costs are anticipated to range from $3,000 to $6,000.

In addition to markings placed on the sealed surface, annual inspection and maintenance of the sealer would be added to the hatchery operations manual. This ensures that institutional knowledge of the PCB issues is maintained into the future. Should cracks be observed in the sealant then that raceway will be taken off-line until the crack is repaired using the manufacturer specified repair products. A water sample will be collected from immediately downstream of the repaired surface and analyzed for PCBs. The results will be reported to the EPA within one month of receipt of the analytical reports.

Should hatchery operations be discontinued at some point in the future, the sealant will be maintained until disposal of the PCB-impacted concrete could be conducted in accordance with applicable State and Federal regulations.

Concerns have been raised that the PCBs remaining in the concrete could migrate outside of the concrete raceways into the surrounding soil. Depth integrated sampling has shown that the concentration of PCBs in the concrete decreases rapidly with depth. The PCB concentration drops by 2 to 3 orders of magnitude from the concrete surface to a depth of 1.5 to 2 inches. This indicates that the PCBs likely penetrated into the concrete at the time the paint was applied and that the PCBs are not continuing to migrate into the concrete. If continued migration of PCBs was occurring at a rate at which environmental impacts would be anticipated, it would likely have penetrated farther than 2 inches in the forty-plus years since the paint was applied. The penetration of the PCBs into the concrete during application is to be expected since concrete is a porous material with air vugs and cracks that would draw in the paint by capillary action. Once the paint dried, the PCBs lost their mobility and stabilized in the concrete. Sealing the surface of the concrete will only increase stability of the PCBs by reducing water and water vapor migration through the concrete.

4.0 SAMPLING AND ANALYTICAL PLAN

Sampling will be conducted to evaluate the effectiveness of the sealant in controlling polychlorinated biphenyl (PCB) migration from the concrete raceways. Four independent methods of sampling will be used, including wipe, algae, fish, and water testing. Samples will be collected at the short and canal raceways since they contained the highest concentrations of PCBs and have the highest potential for the release of PCBs.

Samples will be collected on an annual basis with two periods in which the different media samples are collected. The hatchery operates on an annual cycle, at the end of which the fish are released and the raceways can be drained. An annual inspection will occur when the hatcheries are drained and the raceways can be visually inspected for physical defects in the liner. Wipe and algae samples will be collected during the annual inspection. Pre-annual inspection sampling will occur towards the end of the fish-rearing cycle when they have spent the maximum amount of time in the raceways. Fish and water samples will be collected during the pre-annual inspection. Sampling and analytical plans for each of the media are described in the following sections.

4.1 Algae Sampling

Algae samples will be collected from the raceway walls to evaluate the effectiveness of the sealant in controlling PCB migration from the concrete raceways. Neither the state of Montana nor the EPA has developed cleanup levels for PCBs in algae, thus the results will be compared to background PCB concentrations in algae samples collected from the show pond at the upper hatchery station. The show pond has never been painted so PCB impacts would only be suspected from external sources. Three samples will be collected from the show pond and a statistical analysis will be used to compare the samples from the lower raceways to the show pond sample results.

Samples will be collected on an annual basis. Three samples will be collected from random locations so that statistical analysis can be applied to the results. One control sample will also be collected from the same location each year. The sealant is anticipated to last at least 20 years, therefore 20 sets of sample location maps have been developed using a random sample locator and they are provided in Appendix H. The raceways are depicted with the walls folded flat on the maps. The maps include locations for the random and control samples. Each map is labeled with the calendar year in which it is to be used.

The samples will be collected by scraping the algae from the raceway surface using a decontaminated stainless steel scraper. Decontamination will follow a double wash-triple rinse procedure. The sample equipment will be washed in soapy water, rinsed with tap water, washed with soapy water, rinsed with tap water, and finally rinsed with deionized water. The sampler will don new latex or nitrile gloves prior to collection of each sample. The algae will be placed directly into a laboratory-supplied sample jar and the jar will be labeled with the sample identification number, date, time, and sampler's initials. The sample identification number will note the sample map used and the sample numbers on that map. For example, sample location 1 from Map 2005 will be noted as 2005-1. This procedure will be followed at the control sample location, each of the three random sample locations, and the three show pond locations producing seven algae samples. The show pond locations will be given the location designations of SP-1 through SP-3.

Quality assurance procedures will be followed to ensure the provision of accurate and reliable analytical results. Chain-of-custody forms will be used to track sample custody from sample collection to the analytical laboratory. The samples will be shipped in a cooler, with ice or blue-ice, via overnight carrier or by hand delivery to the analytical laboratory. Chain-of-custody seals will be placed across the cooler lid to ensure that the samples are not tampered with during shipping. The samples will be analyzed for PCBs by a certified laboratory according to EPA Method 8082 with a reporting limit of 0.017 mg/kg.

4.2 Wipe Sampling

Wipe samples will be collected to evaluate the effectiveness of the sealant in controlling polychlorinated biphenyl (PCB) migration from the concrete raceways. If PCBs are detected in the wipe samples, then FWP will notify the EPA and conduct further investigation into the source.

Samples will be collected on an annual basis. Three samples will be collected from random locations so that statistical analysis can be applied to the results. One control sample will also be collected from the same location each year. The sealant is anticipated to last at least 20 years, therefore 20 sets of sample location maps have been developed using a random sample locator and they are provided in Appendix H. The raceways are depicted with the walls folded flat on the maps. The maps include locations for the random and control samples. Each map is labeled with the calendar year in which it is to be used.

The samples will be collected from the same locations as the algae samples (see Section 4.1) following collection of the algae sample. Since the intention of the wipe samples is to detect PCBs that may be migrating through the sealant, then removal of surface debris (algae, etc.) from the sealant surface will be conducted prior to wipe sample collection. This will help prevent the detection of PCBs that may be present from other Site sources rather than the concrete beneath the sealant. Surface debris will be removed by scraping and wiping with a dry cloth. The samples will be collected following the standard wipe test procedure in 40 CFR Part 761.123. A standard-size template (10 centimeters (cm) x 10 cm) will be used to delineate the sampling area. The wiping medium will be a gauze pad of known size which has been saturated with hexane by the analytical laboratory and provided to FWP in a sample jar. The sampler will don latex or nitrile gloves prior to collection of each sample. The template will be decontaminated before collecting each sample using a double wash-triple rinse procedure. The template will be washed in soapy water, rinsed with tap water, washed with soapy water, rinsed with tap water, and finally rinsed with deionized water. The template will be placed on the sealant surface at one of the sample locations shown in the VSP report and the gauze pad wiped within the template area. The gauze pad will be returned to the sample jar and the jar will be labeled with the sample identification number, date, time, and sampler's initials. The sample identification number will note the sample map used and the sample numbers on that map. For example, sample location 1 from Map 2005 will be noted as 2005-1. This procedure will be followed at each of the three sample locations, producing three wipe samples. The control sample will be identified as location 4.

Quality assurance procedures will be followed to ensure the provision of accurate and reliable analytical results. One equipment blank will be collected by wiping a hexane saturated gauze pad over the surface of the decontaminated template. The sample will be labeled with the map identification and the number 5, e.g. 2005-5. Chain-of-custody forms will be used to track sample custody from sample collection to the analytical laboratory. The samples will be shipped in a cooler, with ice or blue-ice, via overnight carrier or by hand delivery to the analytical laboratory. Chain-of-custody seals will be placed across the cooler lid to ensure that the samples are not tampered with during shipping. The samples will be analyzed for PCBs by a certified laboratory according to EPA Method 8082 with a reporting limit of 0.2 ug/wipe.

4.3 Fish Sampling

Fish samples will be collected from the raceways to assess the transfer of PCBs to the fish reared in the raceways. Fish samples will be collected shortly before the fish are released in order to test conditions following their maximum exposure to the raceways. The Department of Public Health and Human Services (DPHHS) has developed meal guidelines for the consumption of fish contaminated with PCBs (DPHHS, 2002) as shown in Table 2.

Table 2. Meal Guidelines for Consumption of Fish Contaminated with PCBs

	Below 0.025 mg/kg	0.025 – 0.10 mg/kg	0.11 – 0.47 mg/kg	>0.47 mg/kg
Meal Advice	Unlimited	1 meal/week	1 meal/month	Don't eat

The U.S. Food and Drug Administration (FDA) has also established tolerances for PCBs in food (Title 21 CFR 109.30). The FDA limit in fish is 2 parts per million PCBs in the edible portion of the fish, which excludes head, scales, viscera, and inedible bones. This level is higher than the "don't eat" level suggested by the DPHHS.

The FWP has used the 1 meal/week guideline (0.10 mg/kg PCBs) for releasing fish from FWP hatcheries. This level is thought to be a conservative limit for released fish in that it is well below the FDA level (2 mg/kg PCBs) and the PCB concentration is anticipated to decrease as the fish grows. Moreover, the risk analysis is based on a lifetime of consuming fish that contain this level of PCB's i.e. one meal per wk for 70 years. The 0.10 mg/kg level is also above the lowest available laboratory detection limit for PCBs in fish of 0.034 mg/kg. Based on these criteria, the action level for PCBs in fish is 0.10 mg/kg.

Four composite fish samples will be collected, one each from the same raceways designated for algae and wipe sample collection (Appendix H). Fifteen fish will be collected from each raceway by FWP personnel and wrapped immediately in aluminum foil and placed in a freezer pending transfer to the laboratory of the FWP Pollution Control Biologist in Helena. The FWP Biologist will remove skinless fillets from each fish and a composite will be prepared of the 15 fish from each raceway. The fish will be ground in a hexane-rinsed stainless steel blender following procedures described by the EPA (1999). Should the EPA request split fish samples, then the quantity of fish collected from each raceway will be doubled and the composite samples split after they have been ground. One sample will be submitted to the FWP contract laboratory and the split sample will be submitted to the EPA.

Quality assurance procedures will be followed to ensure the provision of accurate and reliable analytical results. Chain-of-custody forms will be used to track sample custody from sample collection to the analytical laboratory. The samples will be shipped in a cooler, with ice or blue-ice, via overnight carrier or by hand delivery to the analytical laboratory. Chain-of-custody seals will be placed across the cooler lid to ensure that the samples are not tampered with during shipping. The samples will be analyzed for PCBs by a certified laboratory according to EPA Method 8082 with a reporting limit of 0.033 mg/kg.

4.4 Water Sampling

Water testing will be conducted on an annual basis to assess post-encapsulation PCB concentration in water being released from the raceways. Water testing will also be conducted up-stream from the raceways to assess background conditions.

Both state and federal regulations exist for PCBs in water. The state of Montana Department of Environmental Quality (DEQ) has developed water quality standards for surface and ground water (DEQ, 2002). The PCB surface water standard is 0.0017 micrograms/liter (ug/l) and the PCB ground water standard is 0.5 ug/l, although the required reporting value is 1 ug/l. The surface water standard is significantly lower than the ground water standard because it takes into account bioaccumulation of PCBs in the food chain. The required reporting value is higher than either standard because it reflects DEQ's best determination of a level of analysis that can be achieved in routine sampling.

According to US EPA regulations, PCB-impacted water at the Site can be considered a PCB remediation waste since the PCBs are present as a result of a release to the environment (Title 40 CFR 761.3). The cleanup level for unrestricted use of water is 0.5 ug/l (Title 40 CFR 761.61(a)(4)(iv)). This cleanup level matches the EPA Maximum Contaminant Level of 0.5 ug/l PCBs in drinking water (EPA, 2002a). The EPA regional administrator may also require cleanup to more stringent levels based on proximity to areas such as residences, wetlands, fisheries, etc. The EPA has developed recommended water quality criteria for water (EPA, 2002b) with a freshwater aquatic life criterion continuous concentration (CCC) of 0.014 ug/l. The EPA recommendation for human health for consumption of water plus organism or organism only is 0.000064 ug/l PCBs (EPA, 2002b).

The standard reporting limit for PCBs using EPA Method 8082 is 0.5 ug/l with a method detection limit of 0.11 ug/l. The 0.11 ug/l method detection limit is above the Montana surface water quality standard of 0.0017 ug/l and the EPA recommendation for human health of 0.000064 ug/l. Because detection at the recommended standard concentrations is not achievable using this method, an alternative method developed by the U. S. Geological Survey (USGS) will be used periodically to supplement the standard EPA Method 8082 results, which will be conducted annually.

Samples will be collected on an annual basis for PCB analysis using EPA Method 8082. Three samples will be collected from random locations so that statistical analysis can be applied to the results. One control sample will also be collected from the same location each year. The sealant is anticipated to last at least 20 years, therefore 20 sets of sample location maps have been developed using a random sample locator and they are provided in Appendix H. The raceways are depicted with the walls folded flat on the maps. The maps include locations for the random and control samples. Each map is labeled with the calendar year in which it is to be used.

The USGS has developed a sampling and analytical method for the low level detection of hydrophobic organic contaminants in water (USGS, 2000). The USGS method employs semipermeable membrane devices (SPMDS) filled with lipids that absorb organic compounds. The SPMDS are left in the water for several months and then the total quantity of PCBs absorbed by the devices is measured and a concentration in water is calculated. This method provides much lower detection limits than using EPA Method 8082, with results as low as 0.00001 ug/l PCBs being achievable. Two water samples were collected by FWP personnel in 2004 using SPMDS. One sample was collected from raceway 49, which is one of the short raceways that contains the red and blue paints, while a second background sample was collected from the aeration canal located upstream from the raceways as shown on Figure 5. The sample from raceway 49 indicated a PCB concentration in water of 0.0007 ug/L, which is below all standards except the EPA recommendation for human health for consumption of water plus organism (0.000064 ug/l). The sample from the aeration canal indicated a PCB concentration in water of 0.000016 ug/L, which is below all EPA and DEQ standards.

Water quality monitoring utilizing the USGS SPMDS method will be conducted immediately after the sealant is applied and if those results are below the action level then monitoring will be repeated every five years. Two samples will be collected, one from raceway 49 (sample identifier R49) and a second from the aeration canal (sample identifier AC), which will be used as a background sample. A trip blank (sample identifier LR) will be used to assess the potential for PCB introduction into the SPMDS by unwanted sources. The trip blank is opened when the samples are deployed and retrieved from their sample cans. The SPMDS will be stored and shipped in clean gas-tight metal cans. PCBs will be extracted from the SPMDS by Environmental Science Technologies, St. Joseph, Missouri, using a dialytic recovery method. The extracts will be submitted to Energy Laboratories for total PCB analysis according to EPA Method 8082. The total PCB mass in the sample will be used to calculate a PCB concentration in the water using the USGS protocols (USGS, 2000). Should analytical results exceed the action level, then additional investigation will be conducted to identify the PCB source. Should monitoring indicate that the action levels for water are not exceeded for either event then additional water monitoring will not be conducted.

Chain-of-custody forms will be used to track sample custody from sample collection to the analytical laboratory. The samples will be shipped in a cooler, with ice or blue-ice, via overnight carrier or by hand delivery to the analytical laboratory. Chain-of-custody seals will be placed across the cooler lid to ensure that the samples are not tampered with during shipping.

5.0 REFERENCES

DEQ, 2002, Montana numeric water quality standards, Circular WQB-7.

DPHHS, 2002, 2002 Montana sport fish consumption guidelines.

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Appendix A

Visual Sampling Plan Report

Appendix B

Region 1 Standard Operating Procedure for Sampling Concrete

Appendix C

Laboratory Analytical Reports and Data Validation Forms

Appendix D

PCB Mass Calculation Table

Appendix E

VSP Report for Soil Sampling

Appendix F

Belzona® Product Specifications

Appendix G

Sherwin-Williams Product Specifications

Appendix H.

Sample Location Maps